

# Claims

- [c1] 1. An antenna comprising:  
a ground plane;  
a radiating element spaced above said ground plane;  
a slot having side walls formed in said radiating element;  
and  
an extension of said radiating element within said slot  
and out of physical contact with said side walls.
- [c2] 2. The antenna of claim 1 wherein a portion of said extension is located in a space between said radiating element and said ground plane.
- [c3] 3. The antenna of claim 1 including:  
a shorting post connecting said radiating element to said ground plane;  
an edge on said radiating element;  
said slot having an open end located on said edge and having a closed end located within said radiating element;  
said extension having a first end connected to said radiating element and located generally adjacent to said open end of said slot; and  
said extension having a second end located generally

adjacent to said closed end of said slot.

- [c4] 4. The antenna of claim 3 wherein said second end of said extension is located in a space between said radiating element and said ground plane.
- [c5] 5. The antenna of claim 3 wherein said edge is a non-radiating edge of said radiating element.
- [c6] 6. The antenna of claim 3 wherein said edge is a non-radiating edge of said radiating element.
- [c7] 7. The antenna of claim 6 wherein said shorting post is located generally on said non-radiating edge of said radiating element.
- [c8] 8. The antenna of claim 7 including:  
a feed post on a non-radiating edge.
- [c9] 9. The antenna of claim 3 wherein said edge is a radiating edge of said radiating element and including a feed post on said radiating edge.
- [c10] 10. The antenna of claim 3 wherein said edge is a generally linear edge, wherein said slot is a generally L-shaped slot having a first portion that extends generally perpendicular to said linear edge and a second portion that extends generally parallel to said linear edge, wherein said extension includes a first portion that extends through

said first portion of said slot, and wherein said extension includes a second portion that extends through said second portion of said slot.

[c11] 11. The antenna of claim 10 wherein said second portion of said extension additionally extends into a space between said radiating element and said ground plane.

[c12] 12. The antenna of claim 10 wherein said second portion of said slot meanders in a path that extends generally parallel to said generally linear edge, and wherein said second portion of said extension meanders in a path that extends generally parallel to said generally linear edge.

[c13] 13. The antenna of claim 12 wherein said second portion of said extension additionally extends into a space between said radiating element and said ground plane.

[c14] 14. The antenna of claim 10 wherein said second portion of said slot is a linear portion that extends generally parallel to said generally linear edge, and wherein said second portion of said extension includes a first portion that extends in one direction through said second portion of said slot, a turn-around portion that is located generally at said closed end of said slot, and a third portion that extends in a second direction through said second portion of said slot.

- [c15] 15. The antenna of claim 3 wherein said edge is a non-radiating edge of said radiating element, including:  
a radiating edge on said radiating element;  
a feed post on said radiating edge;  
a shorting post on said non-radiating edge connecting said radiating element to said ground plane;  
said slot having an open end located on said non-radiating edge and a closed end located within said radiating element;  
said extension having a first end connected to said radiating element generally at said open end of said slot;  
and  
said extension having a second end located generally adjacent to said closed end of said slot.
- [c16] 16. The antenna of claim 15 wherein said slot includes a generally linear portion that extends generally perpendicular to said non-radiating edge, and wherein said extension follows a meandering path as it extends through said linear portion of said slot.
- [c17] 17. The antenna of claim 16 wherein said slot includes a first generally linear portion that extends generally perpendicular to said non-radiating edge and a second generally linear portion that extends from said first portion of said slot generally parallel to said non-radiating

edge, wherein said extension includes a first portion that follows a meandering path as it extends through said first linear portion of said slot, and wherein said extension includes a second portion that extends from said first portion of said extension and follows a generally linear path as it extends through said second portion of said slot.

- [c18] 18. The antenna of claim 3 wherein said edge is a non-radiating edge of said radiating element, including:
- a radiating edge on said radiating element;
  - a feed post on said radiating edge;
  - a shorting post on said non-radiating edge connecting said radiating element to said ground plane;
  - said slot having an open end located on said non-radiating edge and a closed end located within said radiating element;
  - said extension having a first portion connected to said radiating element generally adjacent to said open end of said slot so as to position a second end of said first portion generally at a middle of a length of said slot; and
  - said extension having a second portion having a first end connected to said radiating element adjacent to said second end of said first portion, said second portion having a second end located generally adjacent to said closed end of said slot.

- [c19] 19. The antenna of claim 18 wherein said first and second portions of said extension follow meandering paths.
- [c20] 20. The antenna of claim 1 wherein said antenna is a planar antenna selected from the group microstrip antenna and planar inverted-F antenna.
- [c21] 21. An antenna comprising:  
a metal ground plane;  
a metal radiating element spaced from said ground plane;  
a slot having side walls formed in said radiating element;  
and  
a metal element located within said slot and out of physical contact with said side walls.
- [c22] 22. The antenna of claim 21 wherein said metal element is connected to said ground plane.
- [c23] 23. The antenna of claim 22 wherein said ground plane and said radiating element are planar members that extend generally parallel to each other, and wherein at least a portion of said metal element is generally coplanar with said radiating element.
- [c24] 24. The antenna of claim 23 wherein a portion of said metal element lies in a space between said radiating ele-

ment and said ground plane.

[c25] 25. The antenna of claim 23 wherein said radiating element includes an edge, wherein said slot includes a length dimension, a closed end that is located within said radiating element, and an open end that is located on said edge, and wherein said metal element meanders generally along the length of said slot so as to have an effective length dimension that is longer than said length dimension of said slot.

[c26] 26. The antenna of claim 25 including:  
a shorting post connecting said radiating element to said ground plane.

[c27] 27. The antenna of claim 21 wherein said metal element is connected to said radiating element.

[c28] 28. The antenna of claim 27 wherein said ground plane and said radiating element are planar members that extend generally parallel to each other, and wherein at least a portion of said metal element is coplanar with said radiating element.

[c29] 29. The antenna of claim 28 wherein a portion of said metal element lies in a space between said radiating element and said ground plane.

- [c30] 30. The antenna of claim 29 wherein said radiating element includes an edge, wherein said slot includes a length dimension, a closed end that is located within said radiating element, and an open end that is located on said edge, and wherein said metal element meanders generally along said length dimension of said slot so as to have an effective length dimension that is longer than said length dimension of said slot.
- [c31] 31. The antenna of claim 30 including:  
a shorting post connecting said radiating element to said ground plane.
- [c32] 32. The antenna of claim 21 wherein said antenna is selected from the group microstrip antenna and planar inverted-F antenna.
- [c33] 33. A planar antenna comprising:  
a ground plane;  
a radiating element having an edge;  
a shorting post connecting said radiating element to said ground plane;  
a first slot having side walls, an open end that is located on said edge, and a closed end that is located within said radiating element;  
a second slot having side walls, an open end that is located on said edge at a position that is spaced from said



open end of said first slot, and a closed end that is located within said radiating element;  
a first extension of said radiating element entering said first slot at said open end thereof and extending generally along a length of said second slot from said open end to generally said closed end thereof without physically contacting said side walls of said first slot; and  
a second extension of said radiating element entering said second slot at said open end thereof and extending generally along a length of said second slot from said open end to generally said closed end thereof without physically contacting said side walls of said second slot.

[c34] 34. The antenna of claim 33 wherein said first extension of said radiating element follows a path that is selected from the group linear and meandering, and wherein said second extension of said radiating element follows a path that is selected from the group linear and meandering.

[c35] 35. The antenna of claim 34 wherein said antenna is selected from the group microstrip antenna and planar inverted-F antenna.

[c36] 36. A method of controlling the operating parameters of a planar antenna comprising the steps of:  
providing a generally planar metal radiating element

having an edge;  
providing a slot within said radiating element;  
providing that said slot include side walls, an open slot-end that lies on said edge of said radiating element, and a closed slot-end the lies within said radiating element;  
and  
providing a generally planar metal segment;  
providing that at least a portion of said metal segment is coplanar with said radiating element; and  
providing that said metal segment extends generally from said open slot-end to said closed slot-end without physically engaging said side walls.

[c37] 37. The method of claim 36 including the step of:  
electrically connecting said metal segment to said radiating element.

[c38] 38. The method of claim 36 including the step of:  
electrically connecting said metal segment to said radiating element at a location generally adjacent to said open-end of said slot.

[c39] 39. The method of claim 38 including the step of:  
providing said metal segment as a meandering metal segment whose length is greater than a length of said slot.

[c40] 40. The method of claim 36 including the steps of:  
providing a metal ground plane that is generally coplanar  
with said radiating element; and  
electrically connecting said metal segment to said  
ground plane.

[c41] 41. The method of claim 40 including the step of:  
providing said metal segment as a meandering metal  
segment whose length is greater than a length of said  
slot.

[c42] 42. The method of claim 36 including the step of:  
providing a metal ground plane that is generally coplanar  
with said radiating element;  
providing that said metal segment is electrically con-  
necting to one of the group radiating element and  
ground plane; and  
selecting the antenna from the group microstrip antenna  
and planar inverted-F antenna.